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Report: On the St. John Methods of Treating Crude Coal-Gas.

By Professor Henry Wurtz.

To the St John and Rockwell Company—

Gentlemen: I have, at your request, made a chemical investigation of the apparatus and methods in use at the works of the Harlem Gas-Light Company, on the First Avenue, between 110th and 111th streets, New York City: for the treatment of crude gas, to separate the tar and other condensable impurities, preparatory to purification.

This apparatus, as there in use, comprises First: the peculiar Washer patented by Wm. H. St. John, September 2, 1873, No. 142,358 (including some improvements since introduced), in which the crude gas is forced through perforated horizontal screens immersed under the liquids that condense from the gas during the operation itself, together with those that flow from the hydraulic main. Second: The latticework dry scrubber or condenser, patented by St. John and Rockwell April 4, 1871.

My experiments and opportunities for almost continuous observations upon the workings of these new inventions were prolonged for a period of about two months, having commenced during the last week of September, and closed during the last week of November.

As the object of this investigation, I proposed to myself to acquire a complete knowledge of the chemical changes that are impressed on the gas while traversing this combined apparatus. To accomplish this, complete analyses were necessary, both of the gas itself, before and after it had traversed the apparatus, and of the products of condensation at these same stages of the manufacture. In analyzing the gas, I made use of new apparatus and methods recently devised by me for separating completely several constituents of crude gas, at one operation, which have not heretofore been satisfactorily separated in analysis, by any methods hitherto discovered. By means of this new apparatus, it is practicable to detach from each other and weigh separately the following constituents: Tar; water; soot, smoke and dust; (condensable) naphthaline; ammonia; sulphuretted hydrogen; carbonic acid. These comprise all the constituents that are important in connection with the questions to be discussed in this report.

To enable me to carry out my plans, perforations were kindly made for me by Mr. Balmore, the Engineer of the Harlem Company, through the inlet and outlet mains of the scrubbing apparatus, into which I was able to introduce eduction tubes, thermometers, etc., at will.

Two distinct series of analyses were made, one during the month of October, and the other during that of November. At the former date the coal used was a *mixture* of two staple gas-coals; but during the latter month, in order to give a more precise and scientific interest to my results, the charges were confined exclusively to one coal, the Murphy Run coal, of the Monongahela Valley region, in West Virginia. I shall therefore report only upon the November experiments, which were moreover more complete and detailed than those of October (there being, nevertheless, a close general correspondence in all essential points). The results will be found arranged in Tables I and II,* in such manner as to render the high efficiency of these new modes of scrubbing gas visible at a glance to any person skilled in the art.

The theory on which these new washing and scrubbing devices were based by the inventors, may be stated as follows:

1. Tar, as retained by gas after passing the hydraulic seal, is mostly not in a state of solution or homogeneous admixture with the gas, but chiefly suspended mechanically, after the fashion of spray, mist, or fog.

2. The means commouly resorted to, of precipitating or condensing this spray-like matter by refrigeration, or contact with cold water, or both, result in a loss of illuminant constituents of the gas.

3. Modes of straining or filtration are those which would occur to a chemist to meet the case. Ordinary filters would, however, oppose too great resistance; and would at once become clogged. St. John has, therefore, invented here a new method of filtering or straining the gas through what is virtually a liquid gas-filter, composed of the products of its own condensation, which also, so far as spray of tar and water, smoke and condensable naphthaline are concerned, performs the functions of a scrubber, in bringing into play the forces of cohesion and adhesion, without in any degree condensing the gas by refrigeration.

4. After the bulk of the tar, spray, and naphthaline, have thus been strained out mechanically, the gas may be safely submitted to a certain degree of refrigeration, and the dry "Friction-Condenser" or Scrubber, of St. John and Rockwell, now comes usefully into play, for completing the process, and preparing the gas for the purifiers.

It will be observed that my observations show the reduction of temperature of the gas, while traversing the whole combined apporatus, ranges but from 10° to 13° Fahr. The abstraction from the gas, with so small a degree of refrigeration, and with apparatus of such extreme compactness, of such large percentages of tar, soot and naphthaline as shown by my analyses in Table I, and even of very important proportions of the water and ammonia, cannot but be regarded as a triumph of skill, and a great step in advance in gas-purification.

* For Tables see next page.

PHOTOMETRIC RESULTS.

Through circumstances entirely disconnected with your apparatus, I was prevented from obtaining, during November, photometric tests of the Murphy Run gas, then being made unmixed with other gas; but ortunately tests made previous to this while an admixture of Penn coal was being used, to the exclusion of any enriching material, furnish us perfectly accurate means of determining the gain in candle-power due solely to your new methods of scrubbing. My own observations have been long on record, of the yield and candle-power of the Murphy Run gas alone, at Harlem—purified, as now, with iron-oxide (See American Gas-Light Journal for June 16, 1870—Editorial page). This was 4·55 feet per lb. of 18·25 candle-gas, equivalent to 10,000 feet per long ton—or 4·464 feet per lb. avoirdupois—of 18·6 candle power. The average value of Penn coal, when purified with lime, for 4·464 feet per lb., is 15 candles; but as, when purified with iron, it retains 1·8 per cent. of carbonic acid, which reduces the value about 12 per cent., it cannot be rated in this case at over 13·2 candles.

On the 30th of September last, through the consent of Messrs. President Wakeman and Engineer Balmore, I was enabled to make a special experiment, upon the gas from 91,400 lbs. of mixed coals, comprising 66,800 lbs. of Murphy Run and 24,600 lbs. of Penn, or in the ratio of 2.715 of the former to one of the latter—without admixture with any other enriching material or gas. On the above data this mixture ought to give by the ordinary methods of carbonizing at the rate of 4,464 feet, of

$$\frac{18.6 \times 2.715 + 13.2}{2.715 + 1} = 17.15 \text{ candles.}$$

The actual result of this experiment was 4.83 feet per lb. of 16.96 candle-power, which reduces to 4.464 feet, or 10,000 feet per long ton, of 18.35 candles; showing thus a gain of 1.2 candle-power.

The showing which is presented by the figures in the two tables of analyses presented above, is so readily understood, on slight examination, that I shall not occupy sdace in indicating the numerous points of great interest that I might enlarge upon; but shall conclude this report by stating concisely, that the general results of the close, critical, and precise chemical tests that I have applied to your apparatus, completely justify every claim that has been made for it, as the most powerful and compact device for removing from crude gas the condensable constituents, with the least loss of illuminating power, that has yet been discovered.

Respectfully,

Henry Wurtz.

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TABLE I.

ANALYSES OF THE CRUDE GAS.

From Murphy Run Coal—before and after passing the St. John and Rockwell Company's Scrubbers.
Date: November 17, 1874.

Weights: Grains per 100 cubic feet	Crude Gas, from Hydraulic main.	Condensed Gas, from Inlet to purifiers.	Grs. taken out of each 100 feet, by Scrubbers.	Percentage taken out, of each Impurity.
1. Water	3515.2	2674.5	840.7	23.92
2. Tar	515.0	44.0	471.0	91.46
3. Smoke, soot, dust, etc.	265.9	55.7	210.2	79 05
4. Naphthaline (condensable)	123.5	25.0	98.5	79.77
5. Ammonia (NH^3).	339.4	237.0	102.4	30.18
6. Sulphuretted hydrogen	1224.9	1105.1	129.8	10.51
7. Carbonic acid	1698.0	1522.1	176.0	10.36
Totals	7691.9	5663.2	2028.7	26.39
Totals, without the water	4176.7	2988.8	1188.0	26.05
Average Temperatures—Fahr.	107°.5	94°.6		
Volumes: Cubic ft. per hundred.				
Sulphuretted Hydrogen	1.93	1.73	0.20	10.88
Carbonic Acid	2.07	1.86	0.22	10.62

NOTE.—Dividing the above weights by 70 gives, closely enough, the lbs. *per ton* of the Impurities.

TABLE II.

ANALYSES OF THE GAS-LIQUORS.

From the crude gas of the Harlem Gas-Light Company; before and after passing the new Scrubbers of the St. John and Rockwell Company.

Collected October 8, 1874.	Grs. per U. S. gal. of 231 cub. in. = 8·333 lbs av			Percentage increase in scrubbers, over hydraulic main.
Mean temperature of gas, at inlet = 114°.5F " " " " outlet = 104°.5F Temperature of main, over benches, varied from 125° to 130° F.	Liquor flowing from the hydraulic main.	Liquor taken from the scrubbers.	Increase, in scrubbers per gal. from main*	
Sulphuretted hydrogen	90.36	184.90	129.69	143.5 p. c.
Carbonic acid	130.02	671.35	668.94	514.5 "
Ammonia (NH^3)	429.82	790.34	510.75	118.9 "
Soluble tarry matters (acids?)	65.28	14.00	Decrease=48.62	
Water	57612.02	56666.91	9826.41	17·1 "
Totals	58327.50	58327.50	(minus decrease 11087.17	794·0 p.

* These figures are calculated from the known amount of water per ton of coal abstracted from the gas by the Scrubbers, as determined in the Analyses stated in Table I; and on the assumption that the entire volume of gas-liquor per ton of this coal (condensable at about 100° Fahr.) will amount to as much as ten United States gallons; which seems within moderate bounds. I possessed no means of determining the volume, per ton or per thousand feet of gas, of the gas-liquor; and have hence been forced to assume it, as above. If assumed somewhat too high, the figures in the last two columns above will require small proportional reductions.

Perrotte's High and Low Water Indicator.

We find in *Revue Industrielle* a description of Perrotte's apparatus for indicating the height of water in a boiler. The index is operated by a magnet inside the boiler, and does not require any piston or stuffing box. The arrangement is as follows: The rod of a metallic swimmer has a groove at the upper end, and is kept perpendicular by a guide, while, at the same time it imparts a rotary motion to a horizontal axis. This axis has at one end a horse shoe magnet, and this is lightly pressed by a spring against the side, which is made of sheet copper. Outside of this copper wall is an armature of soft iron, which is attracted by the poles of the magnet. The armature is fastened by a pin in the center, upon which it turns, and it carries a needle which plays over a graduated plate. From this arrangement it follows that the needle cannot leave this plate to which it is firmly attached by its joint of support. Two needles may be attached if it is desirable to read on both sides of the graduated circle. This arrangement may be attached to a steam boiler in front, or to the steam dome of a boiler. It is especially adapted to use on locomotives.

The enamelled index plate is divided into three darts, which are of different colors, so as to attract attention at once to the most important points in feeding a boiler, viz., low water, normal height, too high water. An alarm whistle may be connected with it so as to be set in action by the float. The action of the float on the pointer is constant even beyond the divisions of the dial. In ordinary apparatus the float can only operate the whistle when it is suspended from it, and ceases to act just when it is most necessary to know the height of the water.

An apparatus in which the hand has a play of six inches, costs, in France, without whistle, 150 francs, with whistle, 170.

Thermo-Electricity in Iron Ships.—There is a curious point, says *Broad Arrow*, in connection with the deviation of the compass on board iron ships which is now beginning to attract the attention of scientific men, and may therefore perhaps be new to some of our readers. It is now believed that some of the sudden and hitherto unaccountable changes in the deviation of the compasses of iron ships—which are often unsuspected until alleged as the only conceivable cause of the vessel running ashore—are the effects of an unequal and varying distribution of heat over the iron hull; for it is well known that electricity is generated in a metallic substance by heat applied in a certain way, and, in fact, there is a branch of electrical science called thermo-electricity, devoted to the investigation of phenomena of this kind. Sudden slight changes of compass deviation, not exceeding 5 degrees, have been noticed on board iron ships on the North American coast, and these are now attributed to changes in the hull, occasioned by the vessel passing from warm to cold water, and *vice versa*. The warm temperature of the Gulf stream, taken in connection with the cold counter-current, is considered to be quite sufficient to account for many of the suspected compass errors on board iron ships.

Chemical Repertory.

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EDITOR—HENRY WURTZ.

CHEMICAL EXCERPTS.

1313. THE CHICAGO INSURANCE QUESTION.—The specialties of this Journal are quite closely connected with Insurance matters through Water Supply, though it is a branch to which for good reasons we have not heretofore given much direct attention.

The Insurance people seem to be returning rapidly to Chicago, satisfied with the steps taken to guard better against the devouring element. In spite of an impression sought to be spread by some of the Chicago papers, the water-supply seems yet inadequate for fire purposes. The Mayor (Colvin), in a recent message, claimed its adequacy as demonstrated at the fire of last July. Thereupon a writer in the *Tribune* asserts that—

"No fire engine working west of Third avenue could attain a water pressure of over sixty pounds per square inch—about half of what firemen think an ordinary fire pressure."

Some Chicagoans attack General Shaler because he insists on providing more fire-engines at once, before water is available. It is reasonable, however, to claim that the more engines, the more chance of some reaching a fire quickly, which is often all in all.

1314. DRINKING WATER, AND LEAD.—The French chemist Fordos, contrary to some assertions that have had currency, finds that sulphate of soda, chloride of sodium, chloride of ammonium, nitrate of potash, nitrate of ammonia, sluphate of lime, and sulphate of magnesia do not hinder the joint action of water and atmospheric carbonic acid upon metallic lead, and that traces of the lead pass into solution.

1315. SULPHUROUS ACID GAS AND VEGETATION.—By careful investigations in Germany, it has been found that sulphurous acid is pernicious to plants when in air to a greater extent than one part in 200,000 or 300,000, and is much more detrimental than arsenious acid. Speaking of the vapors from the Freiburg works, where arsenic and sulphur are present, Freytag states that leaves exposed die before their time, the cereals vegetating for a time, but bearing no grain. Stoeckhardt says that herbs, turnips, beetroot, kohl-rabi, dahlias, and all plants with strong leaves, suffer less. Fruit trees seldom give any fruit, even in a good year. Trees much exposed were stripped of their leaves. A plant has been known to wither in two hours when only a-thousandth part of sulphurous acid was in the air; and the effect was yet striking with nine times less. With as little as one ten-thousandth, leaves have been destroyed in forty-eight hours, without, however, quite killing the plants. Angus Smith says—

"The air of Manchester will allow no plants to grow."

From his own observation, he is able to believe in the slow dying of trees after several years of exposure to air with acid gases in it to an extent much smaller than what a chemist would call a mere trace. The air of Manchester contains acid, and hence the plants will not grow. Yet the rain of Manchester contains no more acid than the eighty-thousandth part. Dr. Smith says this is a proportion "incredibly small," and yet it is large compared to that found at a distance from the town, where, nevertheless, the vegetation is not perfect.

1316. ANTHRACITE FUEL-BLOCKS.—A Philadelphia paper writes of the Loiseau fuel thusly:

"I saw Mr. Loiseau fill a pail with nineteen pounds of coal waste, to which he added one pound of clay, making only five per cent. of the latter. To this he added a small amount of milk of lime—a simple solution of common lime and water. These were thor-

oughly mixed for a few moments in a wooden vessel which had been an ice cream freezer. The mixture was then placed in a hopper over a compressing roller, having on its outer surface half egg shaped concavities. The machine was set in motion, and immediately the lumps of fuel began to fall on the floor at the bottom of it. I saw some of these lumps taken immediately, without any drying or other preparation and placed upon an anthracite fire in a blacksmith's shop, where a blast made the heat most intense. It ignited immediately, without any cracking or fracture, and burned perfectly, retaining its shape until nearly consumed."

1317. The Artificial-Vanilla Patent.—It has got into the newspapers that two of Hoffman's pupils have discovered how to get the odorous principle of the Vanilla bean artificially from the sap of pine-trees. We are enabled to give the substance of the English patent that has been issued for this to Wilhelm Haarman, Ph.D., analytical chemist, Georgenstrasse, Berlin, Germany. February 25, 1874. Take, first, coniferine; or, secondly, the sap of plants mentioned above which has been purified or liberated from alumina or other impurities; or, thirdly, an extract of all those parts of the just-mentioned plants containing coniferine; or, fourthly, the products obtained from coniferine by means of fermentation, putrefaction, or similar action; and treat one another with oxidising agents or such agents of similar action, such as bichromate of potassium and sulphuric acid, or any other peroxide, oxide, acid or salt, which produce the same effect. The product of the reaction in all these cases is artificial vanilline, which has been proved to be identical in all physical and chemical properties with the aromatic principle obtained by the extraction, etc., of the natural vanilla beans.

1318. Utilisation of the Tides.—M. Lecompte, at a recent *seance* of the Academy of Sciences, proposed the utilization of the ebb and the flow of the tides for compressing air, which will be required in the construction of the proposed tunnel under the British channel, and for driving the boring machines will be used.—*Iron.*

[Somebody in our newspapers has suggested the same regarding the Hudson River Tunnel project, giving no credit.[

1319. Oleaginous.—Petroleum makes a flattering exhibit in our country. Ten years alone mark its development. The export value for the three years past is:

In 1871	$36,454,482
In 1872	33,761,687
In 1873	45,930,367
Total for three years	$116,146,536

There is just this much gain in the wealth of the country from petroleum, and no doubt it will be a source of very large if not increasing income in the future.

1320. Curious Gas-Meter Phenomena.—A New Jersey paper says of a recent heavy gale: "The wind storm yesterday afternoon raised 'Cain' in general. Signs, chimneys, blinds, and awnings were blown away, and considerable damage was done, but without any serious accident to any person. During the storm a singular accident occurred in Meyer's drug store on Union Hill. Just by the door there is placed a wet gas meter, and when the wind was at its height, the 'feed cap' on the meter was blown off, and the water came from it in resemblance to a fountain."

1321. Peekskill Water Supply.—The principal topic of discussion in the village of Peekskill is the introduction of water, which is promised by next July. The Board of Water Commissioners have decided to use the water from the Peekskill Hollow Creek, which is free from objectionable matter. A large dam is to be constructed at Bagley's mill, two miles from the village, and the water will be backed over a large flat, forming a beautiful lake. The water will be pumped from the dam by means of turbine wheels into a reservoir in the "Campgeld" Woods a mile distant, and on an elevation of 350 feet. This reservoir will cover eight acres, and from it the water is to be conveyed to the village. In all the streets pipes have been laid, at a cost of about $50,000. The Legislature authorized the issue of $150,000 bonds to cover the expense, but before the work is finished it is expected it will cost upwards of $300,000.

1322. Washing Bottles.—In the Bulletin of the French Chemical Society, the chemist Fordos points out the danger of using leaden shot in cleansing bottles intended to contain beverages, medicines, etc. In their stead he recommends fragments of iron obtained by clipping up iron wire, No. 16, 17, and 18, giving a quality suitable for phials, and No. 22 for wine bottles. These iron granules have been used on the large scale with very satisfactory results. If there is any fear of injuring the color of choice white wines granulated tin may be used.

1323. Glazing Clay Retorts.—M. L. Jones, Esq., Superintendent of the Frankfort City (Kentucky) Gas-Light Company, writes to the *Scientific American:*

"I have a wrinkle to impart to those of the gas fraternity who have clay retorts. It is well known that clay retorts, when first fired up, are very open and porous, causing considerable loss in the yield of gas; and the same thing happens when they become coated with carbon on the inside and have been recently burned out. If those who use such retorts will, when they are new, coat them (both in and outside) with a solution of sillicate of soda, of the consistence of ordinary syrup, the difficulty will be entirely removed. It is hardly necessary to add that the coating should be done before setting and allowed to dry thoroughly."

Mr. Jones is not alone in thinking this new, as somebody got a patent for it (in England) a year or so since. It has however been in use for several years, to our knowledge, by several parties in this country.

Development and Growth of Iron Pipe Casting,

[Translated for the *Iron Age.*]

From a lecture delivered before an association of gas and water men, at Cassel, in Germany, by A. Ledebur, an engineer from Groditz, we abstract the following:

The first cast iron pipes were made in Germany at the beginning of the 17th century, and were used in the mines. Cast iron water pipes were first made on a large scale in the years 1672 to 1682, at a French foundry, and were used for the water works at Versailles. These pipes were joined by flanges, and the largest were eight inches in diameter. Several of these were placed side by side, showing that they had either not attempted, or not succeeded, in casting pipes of larger diameter. This first large experiment on the use of cast iron for water pipes seems to have met with little encouragement, and during the whole of the 18th century we find only a few isolated notices of pipe casting.

About the middle of the last century the pipes began to be cast in sand, having been previously cast in clay or mud. This was a great advance in the art. Pipes of that day which have come down to us have a considerable thickness with a relatively short length of about 3 to 5 feet. They are usually joined by flanges. Only on pipes that did not have to bear any considerable pressure were muffs employed.

Toward the end of the second decade of the present century the use of illuminating gas began to spread from England over the whole inhabited earth. This opened a new field for the use of cast iron pipes, and the extended use stimulated the manufacturers to contrive means of improving the method of casting, and consequently to improve the quality of the product while decreasing its cost. At the same time the invention of the stronger muff connections supplied its use considerably.

England, which was the most energetic in the introduction of gas illumination, first perfected the casting of iron pipes. While in Germany and France pipes only eight to twelve inches in diameter were cast, and these, too, in short lengths, the English had already learned to cast pipes of every size, and of the lengths still in use. It is only about 20 years since foundries were started in Germany which made a specialty of pipe casting, and in this way only is it possible to drive out English competition more and more. Although the English foundries served as models, it is pleasant to note that the German works were very soon able to stand side by side with the English in perfection, and we can even say without exaggeration that in many cases they excel the English.

One of the reasons for this advance in pipe-casting was the introduction of the upright casting in dry molds. The upright method possesses, as we know, very considerable advantages over the horizontal. For, when the core is placed horizontally in the casting, if the length is considerable, it bends more or less, first downward from its own weight, then upward from the buoyancy of the liquid iron as it flows in, hence the pipe undoubtedly has walls of uneven thickness. This is the reason that it was for a long time impossible to cast tubes longer than four or six feet. The method frequently employed for other kind of castings, of stiffening the core with wrought iron supports, did not answer well for gas and water pipes, since, as a rule, there was a spot about the core prop which was not tight. On the contrary, if the core stands up there is no tendency to bend, and the walls must remain of even and constant thickness if the core is fastened in the right position.

A second advantage of upright casting is that the gases and vapors evolved during the pouring escape more rapidly upward than in a horizontal direction, hence air bubbles are less liable to form in the pipe.

The method of molding to which the pipe casting of the present century owes its first and greatest advance, is as follows:

The mold is first made in a horizontal position. A flask which opens in two equal parts is employed, one-half of the pattern being imbedded in each side of the flask. After the pattern is taken out, the flask is shut together and placed toward evening in a drying chamber. The next day it is taken out, the core introduced, also in a horizontal position, the ends resting in the so-called core marks (Kernmarken), the two halves of the flask are fastened together, the completed mold placed upright, and the metal poured in.

This was for a long time considered a most excellent method, and it rightly deserves praise, for it soon brought pipe casting to a perfection previously unthought of. Still this method possessed many disadvantages, such as the frequent lifting and transporting of the flasks which required the use of cranes, and the loss of time during the drying, which required at least some hours, and during this time all work ceased, for it was customary to put all the molds in the heated chamber at the same time. There were, too, other circumstances which combined to render the work expensive. Notwithstanding the greatest care in placing the core and in adjusting the flask, a bend or slide would sometimes occur. Or the two halves of the flask would not exactly coincide, the centre of one semi-circle not falling upon the center of the other, and the walls of the pipe would be of unequal thickness.

To overcome these difficulties another method of molding was devised and first employed at Fronard near Nancy This method, with greater or less modifications, has been introduced within a few years into most of the large pipe foundries in Germany. It possesses a number of advantages over the previous method.

In the new method the pipe molds are made in a vertical position, the pattern is drawn out vertically,

and the mold is dried in a vertical by passing heated air, or gases produced by combustion, up through them. The two parts of the flask are fastened together before beginning to make the mold, and are not loosened or moved during all these operations. This method saves time, and renders it almost absolutely certain that the walls of the pipe will be of even thickness, for the core, which is let down into the mold, has a wrought iron turned axle which fits into a turned and centred hole in the flask. As the mold consists of only one piece instead of two put together, no seam is formed on the pipe, which was unavoidable by the old method. This seam injured the appearance of the exterior, and by weakening the iron gave rise to leaks. Another circumstance of special importance is that every flask has an independent drying arrangement, generally a portable fire-box, and hence may be dried independently of the others while the molder is making his next mold or casting one already dry. Besides this, the molds dry much faster by hot gases passing through them than in a drying chamber, so much so that the new process much less sand is used than formerly. A large pipe foundry recently erected by a stock company at Groditz, in Saxony, is arranged for making pipes in this way exclusively.

Finally, we may mention briefly a new method of making molds similar in principle to that just described, except that hand labor in stamping the sand is replaced by machinery. This process seems to have an important future before it. For many years the greatest varieties of methods for making pipe molds by machinery were tried in England and gradually abandoned. After this, a pipe foundry at Marquise, near Calais, succeeded in employing machinery, and now several large foundries in Germany are on the point of introducing such machinery. In this method, also, the pattern, which need not be the whole length of the casting, is drawn vertically out of the mold by means of the machine, while the sand about it is packed by stamps worked by machine power, and forming part of the machine itself. As the molding machine cannot be moved from its place, the flask must be moved to another place to be finished, so that other models may be made. The mold is dried in a second place, cast in a third, and so on, until, finally, the empty flask comes back to the machine to be filled again. In this the principle of division of labor is carried out to perfection.

It is obvious that the use of machine made molds can scarcely exert an important influence—certainly not a beneficial one—upon the quality of the pipes made, as compared with the process previously described. The principal advantage consists in the possibility of a larger production in a given time in the same foundry than could be reached by hand labor—that is to say, hastening the work and using the flasks oftener.

When the workmen are energetic and intelligent men, who recognize the advantages of using machinery, it would be an advantage to employ it; but where the workmen themselves do not work more intelligently than machines, it is scarcely advisable to try to aid their labor (for some hand labor is indispensable with every molding machine) by furnishing them with fast working machines for molding.

Gas Manufacture in Paris.

The Parisian company for lighting and heating by gas, founded in 1855 by the union of several companies which, previous to that time, divided the work of lighting Paris, produces a quantity of gas which exceeds annually 140,000,000 of cubic metres, equal in cubic feet, to 4,944,324,000. The manufacture of gas is carried on in ten works, which supply both Paris and its suburbs. They are those of La Villette, Ternes, Passy, Vaugirard, Ivry, Belleville, Sainte Maude, Saint Denis, Boulogne, and Maisons-Alfort.

The chief product of manufacture is gas for lighting. It is obtained either in ordinary gas-retorts, or in the coke-furnaces patented by MM. Pauwels and Dubochet. The coke proceeding from distillation of the coal, when it comes from the retorts, is used for domestic heating, because it is very light; the coke from the furnace, on the other hand, being hard and very dense, is sold either for railway uses or for metallurgical industries.

The company also possesses works in which it treats the sub-products of distillation, and other works in which are prepared the apparatuses either for its exploitation or for the utilisation of its products by trade and the public. It is thus that the tar and ammoniacal waters form the object of special manufacture in one separate establishment, and in three works established in three of the principal gas-works.

The company itself manufactures at La Villette the retorts and all the refractory products it uses in its works; and the arrangement is on such a scale that furnace-pieces can be supplied to gas-works at a distance that may desire them. A copper smith's workshop, also at La Villette, gives the company the means of providing all the apparatus of plate metal required in its operations, such as gasometers, reservoirs for water, tar-condensers, etc. In still another workshop it constructs the gas-engines, which, employed for several years past in different parts of Parisian industry, have popularized the use of gas as a motor force, replacing, advantageously in some cases, the steam-engine, and always with economy manual labor. Lastly, it executes the laying of the pipes by which the gas circulates in the public streets. These operations are of great importance, from the large consumption of gas, and the difficult conditions encountered in the streets of a large city like Paris. To satisfy the requirements of the service the company has devised new processes of laying and jointing the pipes, had recourse to pipes of uncommon diameter, and special apparatus, stop-cocks, etc.

The treatment of tar, the quantity of which annually exceeds 25,000 tons, is done in the central works at La Villette, which contains steam engines with a total force of about 80 horse-power, and employs ordinarily more than 120 workmen. This workshop, completely changed within the last five years, occupies a surface of 5½ hectares. The principal products obtained are—

The light essences, which undergo in one workshop various special treatments, the aim of which is to obtain the commercial products known under the names of benzene, for scouring, application of caoutchouc, etc.; carbolic acid, for preparation of picric acid and disinfection; benzole, primary matter in the manufacture of aniline; a new manufacture, that of anthracene products, employed in the preparation of artificial alizarine, has of late been added to the others. The heavy oil is utilised for conservation of wood, for oil paintings, and the manufacture of smoke black, and can also be advantageously used in heating furnaces and steam boilers. The pitch is employed for agglomeration of slack coal, preparation of artificial bitumen, etc. Lastly, to utilise a residue which is almost without value, and always encumbering, an abundant product in gas-works, coke-dust, the company has recently erected a special workshop in which this dust is agglomerated with pitch. It thus obtains a fuel suitable for heating steam-boilers, and which may be mixed, in a certain proportion, with the coke used in heating gas-furnaces.

To avoid the inconveniences which may arise from the operations of a gas industry in the interior of a place like Paris, several important improvements have recently been introduced. Thus, to render impossible the infiltration of oily products into the ground—the effect of which is to alter the nature of water supplying the wells on neighboring properties—the tars and oils produced are stored in large reservoirs of sheet iron, placed at an elevation on blocks of masonry. These reservoirs are, besides, so arranged as to permit an easy surveillance at their edges, and also to economize a large part of the expense of manual labor at the time of delivery. The oils, received directly on coming out of the serpentines, in iron tanks, are forced by air pressure into the reservoirs. By this simple combination considerable labor is saved, while waste and causes of fire are avoided. Another special arrangement provides for the avoidance of the odorous emanations which would otherwise be produced while the pitch is being manipulated in the basins. This arrangement permits of distributing daily, in the pits, and at a distance of more than 100 metres, without production of vapors, a quantity of more than 180 tons of pitch. Lastly, in the work of prolonged distillation of tar, in order to produce anthracene, an agitator apparatus of special arrangement has been fitted to the boilers, which is kept in action throughout the process. In this way are largely reduced the deposits which form at the bottom of the boilers.

The ammoniacal waters produced by distillation of coal are treated in these special works by means of apparatus devised by M. Mallet. The quantity of ammoniacal products obtained in these works reaches annually about 3,000 tons. The products are sulphate of ammonia, used for manufacture of alum, and in agriculture; its use as manure has been considerably developed within the last four or five years. The nitrogen assimilable by plants occurs in sulphate of ammonia in the fixed state, and so is not liable to be volatilized and lost, like that of Peruvian guano, and of every fermentable matter. Its effects are less rapid than those of guano, but they are more durable. The volatile alkali, or solution of caustic ammonia in water, is used for dyeing, scouring, frigorific machines on Carre's system, etc.

The introduction of special apparatus, combined so that the vapors liberated during the treatment of ammoniacal water are carried to hearths at the foot of tall chimneys, suppresses all inconvenience to the neighborhood, at the same time improving the general conditions of health in the workshops. The new apparatus, manometer and safety-valves, fitted to the boiler for distillation, obviate accidents which might sometimes occur from obstruction of the pipes by ammoniacal salts.

It is also at La Villette, and near the Saint Denis canal and the railways du Nord and de l'Est, that the work for manufacture of refractory products is centralized. The process of crushing and mixture of earths and cements, the kneading of the paste, and the conveyance to the bottom of the work, are effected mechanically with a steam engine of 40 horse-power. The shaping of the pieces, which requires the greatest care, is done only by hand. The workshops, in which the products are dried, are heated, without expense, both by the heat lost from the baking-furnaces, and by the escape steam of the engine, circulating in pipes round the apartment. The baking is done in furnaces having two or four hearths, heated with coke got from the gas-works.

The quantity of retorts made annually is about 3,000. There are produced, besides, more than 20,000 various pieces of extra-refractory composition, for the fitting up of furnaces (blocks, arch-stones, etc.) and a million of refractory bricks.

The company has, further, found a means of utilising the slag from the hearths of gas-furnaces; it is made to enter into a composition containing more than half its weight of this matter, and thus here very hard materials are obtained for paving of workshops, stables, etc.—*Iron.*

Carboniferous Coals of the United States.

The following useful summary of the coal measures of the United States has been made by Professor C. H. Hitchcock, for his forthcoming Geological Atlas of the United States. It must be stated, however, that the summary includes only those coals belonging to the Carboniferous system:

1. New England Basin.—This basin lies in Massachusetts and Rhode Island, and is estimated to cover 750 square miles. The coal is plumbaginous anthracite, used to advantage in some smelting furnaces. Perhaps eleven beds may exist; best seen in Portsmouth, Rhode Island. The maximum thickness is 23 feet. The whole Carboniferous system is supposed to

be 6,500 feet thick, of which 2,500 pertain exclusively to the coal measures.

2. Anthracite Basins in Pennsylvania.—This is the most important coal district in the United States. There are four basins, having an area of 410 square miles, not including the Broad Top semi-anthracite, which amounts to 24 more. The measures are from 2,000 to 3,000 feet thick. The number of distinct beds varies from two to twenty-five, according to the depth of the basin. The maximum amount near Pottsville is given at 207 feet, while the average cannot be far from 70 feet (H. D. Rogers). Macfarlane estimates the area of the adthracite fields in Pennsylvania at 472 square miles, which is 62 square miles more than Rogers's estimate.

3. Appalachian coal field.—This field embraces an area of 62,025 square miles, extending from Pennsylvania to Alabama.

In Pennsylvania the aggregate thickness of the measures is from 825 to 2,535 feet. The area of the bituminous coal is 12.222 square miles, with an average thickness of forty feet of coal. (H. D. Rogers.)

In Maryland the area is 550 square miles, in three separate basins. The strata are 1,500 feet thick. There are thirty-two beds in all; one of 14 feet thick, three of six feet each, others from 1 to 5 feet thick. (P. T. Tyson).

In Virginia (chiefly West Virginia) the coal area embraces 16,000 square miles. On the Kanawha the strata are 1,250 feet thick, with twenty-four beds of coal, of which eleven have an aggregate of 51 feet in thickness. The coals seem best developed on this river. (T. S. Ridgway).

In Ohio, Dr. J. S. Newberry states the area to be more than 10,000 square miles, with a thickness of 1,500 feet, and ten workable beds of coal, corresponding in number and thickness to those of Pennsylvania and West Virginia.

In Eastern Kentucky the area has been stated to be 10,000 square miles. Macfarlane puts it at 8,983 square miles, said to have been derived from actual measurement.

In Tennessee, Prof J. M. Safford states the area of the measures to be 5,100 square miles. One characteristic section gives a thickness of 14 feet. The beds vary locally in their dimensions, some of them being 9 feet thick, but thinning out very rapidly.

In Georgia the area may be represented by 170 square miles.

In Alabama the area marked upon the map amounts to about 9,000 square miles.

4. Michigan basin.—This basin has an area of 6,700 square miles, with 123 feet of measures and 11 feet (maximum) of coal. In the center the coal is thickest, thinning out to nearly the thinness of paper around the edges. (A. Winchell).

5 Illinois basin.—This basin, including Indiana and Western Kentucky, covers an area of 47,188 sq. miles.

In Illinois the measures occupy 36,800 square miles, are 600 feet thick, and contain ten beds of coal with an aggregate thickness of thirty-five feet. (A. H. Worthen).

In Indiana the measures occupy an area of 6,500 square miles, are 650 feet thick, and contain thirteen beds of coal, with an aggregate thickness of 31 feet. (E. T. Cox).

In Western Kentucky the measures are 612 feet, including the milistone grit, and carry eleven beds of coal (E. T. Cox). Their area in Western Kentucky is 3,888 square miles. (S. S. Lyon).

6. Missouri basin.—This basin extends from Iowa to Texas. Estimating from Hayden's map the coal area of Nebraska at 3,600 square miles, the total area of this great basin must be some 97,200 square miles.

In Iowa, Prof. White's map shows an area of 18,000 sqnare miles, which is divided into three parts, each about 200 feet thick. The two lower divisions contain the workable coal, which amounts to 8 feet in the second, but to only twenty inches in the upper. As the highest division is everywhere underlaid by the others, the whole area must be regarded as workable.

In Missouri, Professor G C. Swallow estimates the coal area at 27,000 square miles. The measures are 2,000 feet thick, with twenty coal beds, from a few inches to six feet thick.

In Arkansas there seem to be only two beds of coal which lie below the coal measures proper beneath the conglomerate. (Lesquereux.) D. D. Owen speaks of some beds from four to five feet thick, and estimates the area occupied by productive beds at 12,000 square miles.

In the Indian Territory little is known of coal. The officers of the Missouri, Kansas and Texas Railway Company find good banks of coal at several places along their line, several feet thick. The area upon the map amounts to as much as 13,600 square miles. Since the completion of the map it has been ascertained that the coal measures are covered by the Cretaceous formation for a width of about thirty miles along the valley of the Red River in Texas and the Indian Territory; and also that the tertiary area, extending southerly from Preston, is probably of carboniferous age. These discoveries will enlarge rather than diminish the size of the Missouri basin, since the two fields are probably connected beneath the Cretaceous beds.

In Texas, according to A. R. Roessler, in the "Almanac," the coal measures occupy 6,000 square miles. A bed of coal has been reported near Fort Belknap as four feet thick.

7. Territories.—In Arizona, near Camp Apache, Mr. G. K. Gilbert, of the expedition under the immediate direction of Lieut. G. M. Wheeler, reports a bed of coal belonging to the true Carboniferous series. It is probable that future explorations may develop other coal bearing areas in the Territories.

In respect to other coals, we have various localities of commercial importance, especially in Eastern Virginia and near the Union Pacific Railway. They usually belong to the Triassic or Cretaceous formation, and there are lignites in the Tertiary formations.

Water Supply of Ancient Cities.

BY LIEUT. MC HARDY.

[From the Papers of the Royal Engineers.]

In ancient times the water was always allowed to flow of its own accord from a high source to the reservoir, along a channel prepared for it, called an aqueduct.

Aqueducts existed at a very early date indeed. Among the first mentioned was one erected by Solomon, to convey water from Bethlehem to Jerusalem. It was similar in construction to much more recent works, the conduit being three feet square, and built of freestone, strongly cemented, and coated one inch with plaster. The stones were 15 inches thick.

But the system of aqueducts never reached such perfection as it was carried to in Rome. There vast sums of money were expended on these great public works, and their ruins show that they had been executed in a style of corresponding magnificence.

The first Roman aqueduct was constructed about the year 442 B. C., by the Censor Appius Claudius, whose name it bore. Its total length was about 12 miles.

Another was commenced forty years after this, which brought the waters of the river Anio to Rome, and the expense of the work was defrayed from the spoils taken in the war with Pyrrhus.

Thus, then, were aqueducts from time to time constructed until, in the time of Nerva, A. D. 96, their number had increased to nine, and before the seat of government was removed from Rome to Constantinople there were about twenty altogether.

The management of these works was intrusted to a public officer, and the position he held was considered very important: indeed, the office of *Profectus Aquarum* was only bestowed on those of the highest rank, who had served the State well, and distinguished themselves in war.

As the principle observed in the design of the aqueducts were the same for all, it may be well to consider for a short time the mode of their construction.

From the inlet at the source until the water was delivered in Rome, the stream was conducted along a closed channel or specus, having a regular and uniform slope or fall toward the city.

The inclination given by the Romans varied from 1-200 (Vit.) to 1-400, being much greater than that generally allowed at the present time: but this may have been necessary for the better scouring of the specus and for preventing any deposit of mud or silt.

In order to maintain the channel at the proper levels it had sometimes to be raised on an earthen embankment, or carried on a series of arches, and sometimes sunk underground and tunnelled through rock.

Embankment was employed when the culvert was slightly above the level of the ground, but when valleys had to be crossed the channel ran on the top of lines of arches. When the level was very much above that of the ground, a second or third tier of arches was built on the lowest series, and the specus laid on top of all.

Our notions of Roman waterworks are apt to be exclusively associated with these gigantic erections, but they supported only a small portion of the tota length of the specus. Thus, we find that in the time of Frontinus, At D. 96, the total length of all the aqueducts was about 278 miles, and of these 28 only were supported on arches. But by far the largest part of the channels was below the surface of the ground, for of the 278 miles we find that 243 were underground work. However, the vastness of the conception, and the great energy in execution displayed in the construction of these lines of arches, gives them deservedly a prominent place in our consideration of Roman aqueducts.

The specus were generally made with rectangular section, or with three sides of a rectangle and an arched roof. They varied in size from four feet high by two feet wide, to six feet high by four feet three inches wide.

It will be allowed that this section for an aqueduct is not well suited for keeping the channel clear of deposit, but the great velocity at which the water must have flowed would have tended to counteract this.

The specus were built of stone or brick, except when they were tunnelled through rock, in which case a brick lining was considered unnecessary. In order to make the culvert water tight it was coated carefully on the inside with plaster laid on in separate layers. The tunnelled parts of the line seem to have been coated with plaster equally with the parts having the brick lining. The plaster which Pliny declares was found to be the best, was composed of fresh lime slaked with wine, and rubbed with hog's lard and the juice of figs. This was rather a strange composition for a plaster; never likely to be used in this country. However I have made a little of it, for an experiment, and find that the plaster is very much inferior, on the whole, to cements made now of a far cheaper kind; but the surface becomes very hard and resists water well.

It is natural to suppose that a large quantity of air would be drawn into these channels by the flow of the water; so, to prevent any serious consequences from the air thus becoming accumulated and compressed in the specus, holes were made which communicated with the open air, and presented a ready escape for the compressed air in the interior. These openings were placed about 130 feet apart along the aqueduct.

When the water had been brought to within about seven miles of Rome, it flowed into a settling pond or piscina. The piscina consisted of a large covered space in which the water might spread out; and thus, having lost its velocity, the mud in suspension would be deposited, and the clear water would enter the continuation of the spaces on the other side. The covering consisted of a series of arches forming long vaults, transverse to the line of the aqueduct. The passages for water from vault to vault, were so arranged as to be in echelon, so that the water was checked as much as possible in its passage through the piscina. In some piscine the water passed through four vaults, which were so arranged that two were on a level with the specus, and contiguous, while the

other two were immediately under the first two. The water flowed from one on the top into that below it, and from this passed into the other low vault, rising out of it into the one above, when it again entered the specus The works were all coated with cement, which remains, in many cases, intact at the present day.

When the aqueducts approached the gates of Rome great care seems to have been bestowed on the decorative building of arches, especially when crossing any of the main roads

The specus delivered the water at last into a castellum, or service reservoir, from which proceeded pipes to the public baths, private houses, or public fountains through the town. Some of the pipes emitted water on the spot to those who choose to come for it, and were in fact large public fountains.

The name of the castellum may have been given to these reservoirs from the fact that several similar buildings were erected along the course of the aqueduct, in which resided the soldiers who had to guard the works, and the masons who kept them in repair.

The buik of the people of Rome carried the water from the public fountains, while the higher class had service pipes laid from the castellum to their own cisterns. The quantity of water allowed was regulated by an officer at the castellum, who, by means of cocks, could stop the supply at pleasure. The pipes in which the water was distributed through the town was made of lead or earthenware. The leaden pipes had a section somewhat oval and pointed on the top. They were not soldered, but simply pressed together, and it is just possible that the old Romans knew that two clean surfaces of lead, when pressed firmly together, unite securely and form a perfect joint.

They certainly had the seme dread of the solvent action of soft water on lead which exists at the present day. Vitruvius recommended earthenware pipes on this very ground, because "water conducted through earthen pipes is more wholesome than through lead; indeed," he says, "that conveyed through lead must be injurious to the human system." Their earthenware pipes had generally a diameter of about two inches, and were tongued into one another. In order to strengthen the joints, which were sometimes subjected to a pressure of 200 feet, and, therefore, were liable to give way, the Romans enclosed them in an envelope of mortar, made with pounded brick, which set so firmly as to make the joints the strongest parts of the pipe.

One other point let us notice—that the Romans never brought the water to the light until it was to be used; and on this account they must have had it free from animal and vegetable impurities, which so readily appear in water exposed to the sun's rays.

The Columbia Conduit Company.

In reference to this complication, we cull the following:

The *Pittsburgh Post* of December 9th says: As to the refusal of the District Court to grant the injunction prayed for by the Conduit company against the West Penn Railroad Company, it is stated that the State owned, in fee simple, the old canal, along the line of which the railroad company was constructed, and that the railroad company, in turn, became the purchasers of said property, it is claimed, includes the Powers' Run valley, from bank to bank, the State having previously taken possession of the same by building a culvert and having the bed of the run. The claim is therefore made that the deed for the property obtained last July by the Conduit company from the heirs of Archibald Kirkwood, the original owner of the land, is void, as said heirs could not convey the property that had already been conveyed to the State and by the State to the railroad company. The Conduit company being a private corporation, without the right of eminent domain, had no power, it was held, to take land by compulsory proceedings.

The Court perhaps gave the only decision which could be given under the existing laws. When the Free Pipe bill was passed in March, 1872, Allegheny county was exempted from the operations of the law. Let the Conduit company make application to the next Legislature immediately after it assembles, and if that body is legislating for the welfare of the masses, it cannot, it dare not refuse to give them the right to run their pipes under the West Pennsylvania Railroad. No injury will result to this road or any other simply by laying an oil pipe under it, but a portion of the carrying trade may be taken from the railroad by the operation. The Conduit company have as good right to run their pipes over any and every portion of the State of Pennsylvania as the railroad companies have to run their roads, and the people should demand of the Legislature in terms which cannot be misunderstood, that this right be granted immediately on the assembling of that body in Harrisburg. Railroads and pipe lines should be granted and guaranteed equal privileges—neither of which should be permitted to monopolize the carrying trade by special privileges conferred.

Ventilation in Public Buildings.

A few weeks ago, in the House of Commons, Sir Charles Bowyer called attention to its defective ventilation, and addressed a remonstrance on the subject to Mr. Baikes, the chairman of committee. He complained of great want of fresh air. At present, under Dr. Percy's arrangements, all the windows of the House are closed to entirely prevent the admission of fresh air. This, however, is supplied at the bottom of the House, after being cooled by passage over ice, the cost of the latter, at the time referred to, being about £20 per week. Formerly, during hot weather, the windows were opened, a method which Sir Charles greatly preferred, as he and other members, only 150 being present, suffered greatly from the closeness of the atmosphere. At the time the temperature of the external air was upward of 80° in the shade. Various opinions were expressed by other members, and it was explained that if the windows were opened the whole of the existing ventilation would be stopped. Eventually Mr. Raikes, being anxious for the comfort of everybody, promised to look into the matter to see if any improvement could be effected.

If after the expenditure of so many thousand pounds, and the employment of such eminent men as Reid, Goldsworthy Gurney, Percy and others, the ventilation of the Houses of Parliament is defective, it is no matter of surprise that other buildings should show equal if not greater defects. Take, for example, the reading room of the British Museum. Last winter its temperature was frequently from 30° to 40° greater than the external atmosphere, all windows and doors being closed. Hence a change from the close heated atmosphere into the cold air had a most prejudicial if not dangerous effect on the readers. In the summer the entrance doors to the reading room, and the doors in the gallery, are kept wide open. From the latter a downdraught of cold air falls on the heads of all sitting at the circumference of the room, producing catarrh, neuralgia, etc.

Turning to our churches, chapels and other large places of resort, especially theatres, the evils of defective ventilation are more severely felt, even in the winter, and much more so in weather such as we had lately. Within an hour of the audience of most of these places being seated, the emanations of heat, vapor, and carbonic acid from the lungs and bodies produce the certain effect of heating and vitiating the atmosphere. We admit that there are fortunately some excellent exceptions to this rule in the metropolis and other cities. But the experience of many of our readers will prove that such favorable exceptions are very rare.

Much has been said, written and done in regard to improved ventilation in such places, but for some years past the subject has almost ceased to have received adequate notice. The laws of ventilation are simple enough. The fresh air being the coolest, and consequently the heaviest, must be allowed to enter at the lower part of the building, while the heated air, being necessarily lighter, should escape at the upper part of the building.

It is chiefly to the latter point that architects, builders and others direct their attention. They generally allow quite sufficient means of exit for the foul air, neglect to afford adequate means of entrance for an equal amount of cold, fresh air. Ventilation, in fact, consists of a balance between these two points, in which, however, it is desirable that the total of air admitted should have a preponderance. It is much to be desired that this subject should receive still further and earnest attention. Even as regards house ventilation much has to be done, for, if a proper system were adopted, many of the evils now arising from the emanation of sewer gases would be entirely obviated, beside the general sanitary benefits which would arise from effectively ventilated sitting and bed rooms. —*Engineering.*

New Biblical Version.

[Some "scientific person," evidently quite competent to the task, has undertaken, in the *Cincinnati Commercial*, to supply the new readings of Genesis which will be necessarily required by those who have been led into Darwin's "mire of assertion," with the improvements of Spencer, Huxley, and Tyndal, and who still retain some hankering after the faith of their forefathers.—EDITOR.]

1. Primarily the Unknowable moved upon cosmos and evolved protoplasm.

2. And protoplasm was inorganic and undifferentiated, containing all things in potential energy; and a spirit of evolution moved upon the fluid mass.

3. And the Unknowable said, Let atoms attract; and their contact begat light, heat, and electricity.

4. And the Unconditioned differentiated the atoms, each after its kind; and their combinations begat rock, air, and water.

5. And there went out a spirit of evolution from the Unconditioned, and working in protoplasm, by accretion and absorption produced the organic cell.

6. And cell by nutrition evolved primordial germ, and germ developed protogene; and protogene begat eozoon, and eozoon begat monad, and monad beget animalcule.

7. And animalcule begat ephemera; then began creeping things to multiply on the face of the earth.

8. And earthy atom in vegetable protoplasm begat the molecule, and thence came all grass and every herb in the earth.

9. And animalcule in the water evolved fins, tails, claws, and scales; and in the air wings and beaks; and on the land they sprouted such organs as were necessary as played upon by the environment.

10. And by accretion and absorption came the radiata and mollusca, and mollusca begat articulata, and articulata begat vertebrata.

11. Now these are the generation of the higher vertebrata, in the cosmic period that the Unknowable evoluted the bipedal mammalia.

12. And every man of the earth, while he was yet a monkey, and the horse while he was a hipparion, and the hipparion before he was an oredon.

13. Out of the ascidian came the amphibian and begat the pentadactyle: and the pentadactyle by inheritance and selection produced the hylobate, from which are the simiadæ in all their tribes.

14. And out of the simiadæ the lemur prevailed above his fellows and produced the platyrhine monkey.

15. And the platyrhine begat the catarrhine, and the catarrhine monkey begat the anthropoid ape, and the ape begat the longimanous orang, and the orang begat the chimpanzee, and the chimpanzee evolnted the what-is-it.

16. And the what-is-it went into the land of Nod and took him a wife of the longimanous gibbons.

17. And in process of the cosmic period were born unto them and their children the anthropomorphic primordial types.

18. The homunculus, the prognathus, the troglodyte, the autochthon, the terragen—these are the generations of primeval man.

19. And primeval man was naked and not ashamed, but lived in quadrumanous innocence, and struggled mightily to harmonize with the environment.

20. And by inheritance and natural selection did he progress from the stable and homogeneous to the complex and heterogeneous—for the weakest died and the strongest grew and multiplied.

21. And man grew a thumb for that he had need of it, and developed capacities for prey.

22. For, behold the swiftest men caught the most animals, and the swiftest animals got away from the

most men; wherefore the slow animals were eaten and the slow men starved to death.

23. And as types were differentiated the weaker types continually disappeared.

24. And the earth was filled with violence; for man strove with man, and tribe with tribe, whereby they killed off the weak and foolish and secured the survival of the gttest.

Engineering Two Thousand Years Ago.

Perhaps some of the most remarkable remains of ancient engineering are those which were discovered by excavations made some ten or twelve years since, a short distance from Rome, and near the ruins of the ancient city of Alatri. This city was surrounded by massive walls, and located on a mountain or elevated point, and ill provided with water. Abont 100 years before Christ, as we learn from a Roman inscription, an immense aqueduct was built to bring water from a neighboring mountain better supplied with that element. We are furthermore told that this aqueduct was 340 feet high, supported upon arches and provided with strong pipes. The topography of the country, moreover, assures us that the water supply could not have been conducted into the city, even over such high supports, except by pipes—an inverted syphon—the lowest point of which must have been some 340 feet below the point of delivery, or under a pressure of at least ten atmospheres.

The excavations already alluded to show that the aqueduct must have been of large size, as the piers of the arches are not less than five feet nine inches in breadth, while the total length of the syphon must have been between four and five miles. The question naturally arises: How, and of what material, was this syphon built? As iron pipes of large dimensions at all, were not known at that era, we can look only to masonry or woodwork for the material of such construction. Possibly a clue has been found to the mode of their construction by a subsequent discovery, near the same locality, of a field, supposed to have been the site of an ancient parade ground near this once walled city of Alatri. A complete system of underground drainage has been revealed at a depth of about seven feet below the surface of the field, effected by a well constructed system of pipes made of fireclay, each about eighteen inches in diameter. It is possible that such a pipe, of larger dimen,ions, and strengthened on its exterior by a strong and massive bulwark of masonry, may have been the means of conveying the water into the city. But however that end might have been attained, the work was certainly a most wonderful feat of engineering, considering the condition of the mechanic arts of that early day. The excavations and discoveries thus brought to light, and so fully confirming the truth of the ancient inscription, were conducted by order of the present Pope, and under the immediate supervision of the well known Italian scientist, Father Secchi.

Nova Scotia and Cape Breton Coals.

[Correspondence of the "Engineering and Mining Journal."]

"The imports of provincial coal into New York for 1874 up to November 1st, amount to only *about* 32,000 *tons*, yielding the paltry revenue of $24,000. The falling off in the importation of these coals is not due to any extent to the present tariff, but simply to the fact that they are not generally adapted to the wants of consumers. To demonstrate this, it is only necessary to refer to the very low price at which these coals could have been imported into New York, the present season, as compared with the cost of the domestic coals, used for the same purpose.

"The gas companies of New York city and immediate vicinity require abont 500,000 tons of coal annually. The cost of the Pennsylvania coals used by these companies the present year has been $7.50 per ton of 2,240 lb., at the wharf in New York, and this price is considered a satisfactory one by both purchaser and seller: whereas, the best gas coals from the provinces, although costing to import an average of only about $5 currency per ton (duty paid), have found a market here to the extent of say 32,000 tons —*about one-sixteenth of the quantity required for gas manufacture.* The quantity of provincial coal that can be imported into New York for other purposes than for gas manufacture is too insignificant to mention. If, with an advantage of $2.20 per ton in cost, these coals find such a small sale, it certainly will not be maintained that the removal of the duty of 75 cents per ton will have much effect on the interests of our domestic collieries. If we turn to the other side of the question we note that while the United States, including New England markets, will import in 1874 only about 50,000 tons of coal from the provinces, on which we collect a duty of 75 cents per ton, the dominion of Canada will import in 1874 nearly 200,000 tons of American coal, which is admitted free of duty. An annual increase of from 10 to 20 per cent. in this latter trade is confidently predicted.

"It has been estimated that if the Reciprocity Treaty should fail of acceptance by either the Canadians or ourselves—and it appears to meet about as much opposition on that side as on this—a duty would be levied by Canada on the importation of our coals. While, perhaps, we could not complain with a good grace of such a proceeding, it is quite evident it would be very injurious to our interests, and especially to those of the Pennsylvania coal fields, which mine the bulk of our shipments to Canada.

"Would it not be to our interest to place coal on the free list, should the Reciprocity Treaty fail, if by so doing we continue to obtain the free entry to the Canadian markets?"

Peat Manufacture.

PROFESSOR P. H. VAN DER WEYDE.

Among the different peat machines devised to transform peat into an available fuel, there are some intended to overcome the main objection to this fuel, its porosity and consequent lightness with great bulk, and the pertinacity with which water remains in the material, which results in great difficulty of drying—this, of course, reducing the value as fuel greatly. The machines which overcome these objections accomplish it by the application of heat and great pressure, and one of them experimented with in a secluded nook on the Hudson River has lately succeeded in compressing the peat into solid masses as hard as coal and even capable of receiving a polish on the surface, which proves an enormous change in the molecular structure of so porous a material.

The peat is first heated by coils filled with superheated steam, stirred by the machinery, and after the water has escaped, so far heated that part of the pyroligneous and tarry products of the wood fiber are developed, which then serve as a cement when the powerful hydraulic pressure is applied. The whole operation takes only thirty minutes, and is a striking illustration how mechanical art can perform in a short time a transformation which it took nature millions of centuries to accomplish in our coal beds, which are nothing but vegetable peat-like remains of vegetation changed by pressure and more or less heat into the different qualities of coal.

As this class of real machines gives a direct practical proof of the correctness of our geological theory of the formation of the coal beds, Prof. Van der Weyde thought it interesting to bring the information of this fact before the members of the association.—*Amer. Association at Hartford.*

A Contrast of Cost.

The figures showing the cost of street-cleaning in Paris, give $300,000 as the sum which the city government pays to keep the streets of the French capital in preper condition. The contractors receive about $200,000 for the rubbish and dirt when it is delivered outside the city's wall, and Paris is kept clean and wholesome. This question of cost is one which admits of a severe comparison.

Paris is, from its situation, by no means as easy to "clean up for Sunday" as New York. It has not the facilities which New York possesses of a water front for the easy transportation of the refuse—and yrt we find that here consilderably over $4,000,000 per year is paid to somebody ostensibly for cleaning the streets. The contrast of cities, which a foreigner cannot help but mark, is discreditable to New York, where there should at least be a pretension of cleanliness, if pretensions be founded upon expenditure. A few lessons from Paris would be worth paying for, and an item of comparison with the Parisian system of street-cleaning bill of expense as any other. It might be worth the money—just to see how they do it over the sea.—*Evening Express.*

Liabilities of Gas Companies.—We recently stated that judgment for $2,000 was obtained by Elizabeth Money against the Metropolitan Gas Company for wrongfully cutting off her gas. From the judgment an appeal was taken to the Superior Court, General Term, which rendered its decision in the case, Chief Justice Monell writing the opinion of the Court. The plaintiff kept a boarding house, and from the 25th of August, 1871, she was supplied regularly with gas until the 7th of October, when, on a dispute arising about an unpaid bill, the defendants cut off the gas. The verdict was for a loss in her business. It was claimed by the gas company that the plaintiff was in arrears for a former bill. This was denied, the counter allegation being that her husband was in possession of the house when the disputed bill was incurred. The Court held that the right to shut off gas does not extend to arrears created by former occupants. As to the damages, however, it is held that they are too remote to be sustained on an action on the contract itself, and on the latter ground the judgment was reversed.

Parsons and Church's Chemical Works Destroyed.—At 12 30 Christmas morning a fire broke out at the Chemical Works belonging to Messrs Parsons & Church, at the corner of Twentieth street and Avenue B. The origin of the fire is unknown. Capt. Gunner, with a large number of policemen, was quickly on hand. In the building, which is of brick, were two tanks containing 10,000 gallons of tar, and when the firemen arrived these tanks were found to be nearly red hot. The corner of the building was completely gutted. The total loss amounted to $10,000 on the building and material destroyed.—*World.*

[This firm, we believe, was one of those carrying on the ammonia manufacture, which the Smelling Committee of the Board of Health are *said* to have been dissatisfied with. Of our own knowledge we know little or naught thereof, as we have never *yet* seen a copy of the report of that committee.]

The City's Gas.—The Gas Commission, consisting of the Mayor, the Comptroller, and the Commissioner of Public Works, met yesterday at the Mayor's Office and awarded the contracts for lighting the city with gas during the first four months of 1875. The awards were as follows: New York Gas-Light Company, $12 per lamp for all that portion of the city lying below Canal street; Manhattan Company, from from Canal and Grand streets to Thirty-fourth street, $12 a lamp; Mutual Company, $12.66⅔ per lamp for a part of the old Metropolitan District; the remainder of that district to the Metropolitan Company at $15 per lamp; Harlem Gas Company, $13 95 per lamp for the district lying north of Seventy-ninth street.—*World, Dec.* 11.

Penn Gas Coal Company's Railroad.—The track is now laid on this company's railroad, which now runs from the Pennsylvania road to Irwin, Pa., southwest to the Youghiogheny river at the mouth of the Big Sewickley. It is seven miles long and is intended for the transportation of coal. It will furnish an outlet for a large extent of coal land on which the company is now opening several mines.

☞ *For other reading matter see page* 10.

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SATURDAY, JANUARY 2, 1875.

WISHING TO MAKE THIS JOURNAL an organ of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, the publishers solicit letters from all among them who make the study of these subjects a pleasure, or a profession.

Subscribers would confer a favor upon us by remitting *CHECKS*, or *POST OFFICE MONEY ORDERS*, as we are frequent losers where money is enclosed in letters.

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THE METHODS OF THE ST. JOHN AND ROCKWELL COMPANY.

Many of our readers are probably aware of the experiments that have been in progress now for many months, at Harlem, with these new condensing methods; and all will no doubt be glad to have the complete and satisfactory information on this subject which we are now enabled to put before them, in this and the next issue.

In this issue is the report of the results of a chemical investigation made by the Editor, which speaks for itself; and in the next will be given cuts and specifications of the apparatus as a whole.

Part of it—the lattice-work scrubber of St. John and Rockwell—has already been placed before our readers nearly four years since, May 2, 1871; but one of the most important, novel and essential features of the apparatus now commended to the attention of the profession, has been added thereto much more recently, namely, the peculiar washer of St. John described in the Editor's Report, and which will be included in the promised cuts.

We are here called upon to explain also that it was intended to present in this issue the new methods of analysis devised by the Editor, for general use in investigations of the class to which this one pertains—investigations to test by exact chemical means the efficiency of all and any devices used or proposed for the treatment of crude gas from any material, to fit the same for the use of the consumer. A portion of these methods were explained in outline to the Gas-Light Association, at their last October meeting in Brooklyn, with some brief experimental illustrations, and the author was honored and gratified by receiving a vote of thanks from the Association for the communication.

These new methods and apparatus were employed in obtaining the tests of the practical working of Messrs. St. John and Rockwell's devices. The delay in presenting them to the public has been due chiefly to the fact that some quite elaborate cuts have been in hand, taken from photographs of some of the apparatus. These cuts owing to "circumstances beyond our control," and which are "not altogether unconnected with" the holidays, will not be quite in time for this issue.

The delays that have arisen in completing this publication, may probably be looked upon, however, as in some degree compensated by the fact that everything will be ready for the next issue, to be put, in a graphic shape, before the eyes of all, and the figures obtained in the chemical analyses being already then on record in this issue, may be readily referred and recurred to in further discussion thereof; and readers of our journal will be in position to grasp, with somewhat greater readiness, the sum and substance of the whole matter.

We have no hesitation nevertheless, in here anticipating somewhat; by asserting our conviction that the sum and substance will be acknowledged to be that St. John—whose name is already high on the roll of the gas-profession, as one of our most acute, original, practical, and successful inventors—has now produced a device which, in originality, and practical success at the very first trial, has seldom been excelled in the history of gas-science.

THE PETROLEUM-GAS QUESTION.

In this issue, space being precious, we shall, in continuation of this topic, be confined to the bare fulfillment of our promise of the last issue, to illustrate our position that the oil-production strides on, with seven leagued boots, in such manner that plotters to control it are and must be trodden under foot, and become but chaff before the wind.

That we are enabled to do this, our readers and ourselves have to thank Mr. S. H. Paine, the Editor of the *National Oil Journal*, of Pittsburgh, who has most munificently placed at our disposal many columns of figures prepared with care and labor, from sources not easily attainable by us, and intended by him for his own next issue; but which, with serene generosity, he transmits us in MSS., body and bones, without extenuation or reservation.

In our next we shall give Mr. Paine's tables, which go back to January 1870, in full; but must now confine ourselves to the last two years, as follows:

Daily average production. Bbls. of 42 gals.

	1873.	1874.
January	20,407	37,653
February	21,725	29,836
March	21,461	24,629
April	21,384	25,958
May	25,044	25,121
June	26,449	——
July	27,983	33,337
August	30,198	30,049
September	31,809	28,021
October	30,403	29,669
November	33,049	28,702
December	34,980	——
Means	27,074	29,297

Stocks of Crude, in the Producing Region, on first of each month of 1874. Barrels.

January	1,625,157
February	1,948,919
March	2,283,032
April	2,528,219
May	2,623,534
June	2,503,246
July	——
August	2,794,790
September	2,932,444
October	2,758,504
November	3,134,902
December	3,449,845

Mr. Paine takes care to state, regarding the last column, that this is only the stock of *crude*, left on hand, in store, in the *oil region*. The stocks at Cleveland, Pittsburgh, New York, Philadelphia, etc., cannot be got at with accuracy.

It will be observed therefore that our estimate in our last note of a total surplus of four millions in the country, January 1st, 1875, must be very liberally below the mark.

From the daily yields in 1873 and 1874 it is easily calculated that the increase of total yield in 1874—spite of the abortive efforts to stem the tide, the effects of which show somewhat during the three spring months, was about a million and a quarter bbls., or more than fifty million gallons of oil.

We need not pursue further this part of our subject. It seems incredible that any one who will take in the figures that have been given, and will consider without prejudice their bearing on the question of supply of this new material for gas-purposes, should now continue to maintain that there is any danger of its falling off suddenly, so as to leave the gas-interest, after adopting the new material, stranded high and dry on empty oil-tanks as some have imagined. The outlook admits of no such fantastic fears, when viewed with a practical eye.

OBITUARY: THOMAS PRATT.

The tragedy of Mayor Blake, of Worcester, has not yet faded from the memory of any of us; and now we are called on to record a very similar case, in which another of the older and better known members of the fraternity has been stricken down in harness, without warning, by the Inscrutable Will, to whose behests while we lament we yet must humbly bow.

In the case of Mr. Pratt, the immediate cause of the fatality seems so imperfectly recorded, that it is best we should merely state the facts, as kindly communicated to us through reliable private sources, and each reader can then draw such conclusions as he thinks fitting.

Mr. Pratt, who was chief engineer of the St. Louis gas works, and has been such for a quarter of a century; about 3 P. M., on *Sundaay* December 13, went into one of the purifier rooms, to make an examination. In a few minutes afterwards a loud explosion was heard, and four of the employees immediately rushed for the purifying house. They found, on entering the building, Mr. Pratt lying dead on the iron floor, within sixteen feet of the door, and they noticed that one of the purifying tanks had exploded.

The body was removed from the works to his residence, No. 633 South Fifth street.

This purifier room was 50 feet square, containing four purifiers 21 feet square and four feet deep. These had been idle for nearly a year. They had been put in operation again for a week and did not work satisfactorily. For this reason, Mr. Pratt went into the room to learn the cause of the trouble.

Mr. Pratt was thrown some twenty feet, struck the edge of one of the tanks, which crushed his chest, and in falling his head was severely bruised. The cover of the tank was torn off and twisted, and the lime shelves were curled up and scattered. The force of the concussion tore a large window out of the building.

Nothing essential seems to have been elicited at the inquest, except an opinion from one employe of the company, that "the explosion was caused by Mr. Pratt trying the air-valve when there was a back draft into the tank." We quote here from the newspaper report. The verdict was merely death from "an explosion of the gas purifying tank, from some cause not known."

Thomas Pratt was born at Loughborough, County of Leicester, England, in 1802. In 1827 he emigrated to the United States, and the same year returned to Calais, France, where he remained five years and then went to London, in both of which places he worked at gasfitting.

On November 4th, 1834, he left for the United States; landing in New York, from whence he went to Pittsburgh, where he worked for the gas company in 1837, and removed to Cincinnati in 1842, acting as superintendent and chief engineer of the gas works there. He went to St. Louis in 1848, to take a similar position, which he held up to the time of his violent and sudden death.

Although near 73 years of age, he was a youth in energy, and, among other great business operations, one of his latest projects was the reviving and working of the Chihuahua silver mines in Mexico. Another was the introduction of a new dry gas-scrubber, founded on the principle of prolonged contact with extended surfaces, a principle in which he had enthusiastic confidence.

He was also largely interested as a stockholder and builder in the gas works of Kansas City and St. Joseph, Mo., Quincy, Ill., Denver, Col., and several other Western cities. His accumulated fortune is estimated at a large figure.

He leaves a son, Chas. R. Pratt, Esq., who is superintendent of the St. Louis Gas Works.

The funeral was an impressive occasion; the line of carriages is stated to have been over two miles in length. In the resolution of his Board of Directors occurs the following passage:

"His integrity, capacity and efficiency in the economical management of the gas-works, make his loss very severely felt. He was upright in all his business relations, and by his many good qualities won the respect and esteem of those who were associated with him."

1 8 7 4 : OUR REPORT OF PROGRESS.

In a "panic" year like that last past, it is not to be expected that we should find many new or achieved facts to report; but *ideas* nevertheless, which are achievement, in embryo, have progressed during 1874. Old ideas, conflicting with errors and prejudices still more ancient, have made headway against their antagonists, and new ideas have been born. Indeed we incline to the view taken by some that such times of paralysis in material progress, carry with them, in communities like ours, their own compensation; inasmuch as they stimulate Invention, of which "Necessity is the mother." Men have more time also to think, and to digest their thoughts; and, it may be, that could we be endowed with panscopic powers, we should discover that many thoughts have had their birth, since the great crash of the Fall of 1873, that are destined to revolutionize human arts, or to confer upon Man new powers over Nature.

To proceed to particulars: Let us first glance at some of the few positive new achievements of 1874, which, though few are not wholly wanting. First of these, we must rank the new and very remarkable invention of Wm. H St. John, which is sufficiently described in other columns of this issue—namely, his apparatus for straining crude gas through the products of its first condensation, thus taking out the suspended matters and naphthaline *without any condensation* properly so-called. Dry-scrubbing of crude gas—which received its first impulse, in the columns of this Journal now nearly four years ago, from the same inventor, in conjunction with Mr. Rockwell—has also been carried out among us during the last year with more or less success in several quarters. Besides the St. John and Rockwell apparatus, for this purpose, Mr. Pratt of St. Louis—who has met so sad an end—was engaged it seems, with other parties, in the demonstration of a similar principle. The New Haven Gas-Light Company, as stated in our last, are also experimenting on a large scale, with success so far as naphthaline goes, in the same general direction.

Another accomplished fact of 1874 was the commencement of the new Geological Survey of Pennsylvania, which interests us in view of its possibilities—if conducted with application of the science and skill of the present day—of results of great value to the gas and fuel interests. During 1874 have commenced, in Pennsylvania, the first applications, on a working scale, of natural gas of gas-wells to the manufacture of iron and steel. Mr. Charles Plagge, who undertook to bring about a testing of some of the ideas promulgated by the Editor of this Journal regarding the discovery of such natural gas over large sections of New York. has doubtless been delayed by the exigencies of the times; but we trust, has not abandoned this grand and beneficent enterprise.

During the year past have grown up also the so-called "Training Schools," or Schools of Cookery; which may be made, as we believe, an important instrument in the education of our people—scarce yet begun—in the art of gas cookery.

[EDITORIAL NOTE.—The above are but the first paragraphs of an extended editorial, chiefly crowded over till January 16.]

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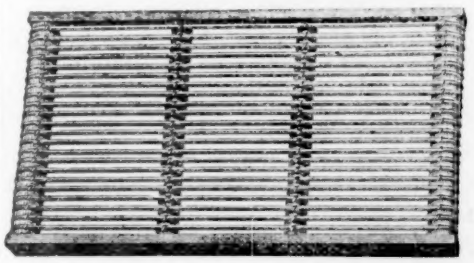

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42 Pine Street, N. Y.

Gems and Generalities.

We have from St. Louis—as yet without details—the terrible news that one of the purifiers of the St. Louis Gas-Light Company exploded December 13, instantly killing Thomas Pratt, Esq., the Engineer and Superintendent of that company.

[Later.—See Editorial page.]

The puddlers strike in Pittsburgh caused a withdrawal from money-circulation in that community alone, of about $150,000 per day.

December 14 the Brooklyn Aldermen resolved on a plan by which the unemployed laboring men of the city can be set at work to build a new reservoir on the eleven acres of land owned by the city at Cypress Hills. The men are to be paid by orders on the Charity Commissioners for groceries and coal.

At Weehawken, long lines of oil tank cars stand upon the side tracks, awaiting the orders for oil at the warehouse. The trade is reported brisk, but at very low figures.

Troy, New York, has been trying naphtha street lamps and pronounces them failures.

Union Hill, N. J., people, on the other hand, are clamoring for the removal of their street gas-lanterns and the substitution of naphtha-vapor lamps. We would advise them to consult the people of Titusville, Pa., one of the "head-centers" of naphtha, as to *their* experience in this thing.

Pottsdam, Me., has an artesian well more than a mile deep.

We did'nt think that oleo-margarine would *go down* in this country. Sure enough it has *gone up* instead. *Videsne puer?*

The oleo-margarine factory on Grove street, Jersey city, was sold by the sheriff yesterday.—*Daily paper, Dec.* 20.

More Rhymes for the Times.—

"Then promise me love,"—and her voice fainter grew—
"While this body of mine calcifies,
You will stand just as near as you can to the flue,
And gaze while my gases arise."

"Servant-Gal-ism."—"Grandma, why don't you keep a servant any longer?" "Well, you see, my child, I'm getting old now, and can't take care of one as I used to do, you know."

A disagreeable discovery has been made at Tooting, England. At an official inquiry which was opened by the Government Inspector of Burial Boards into certain allegations respecting the arrangements of Tooting Cemetery, it incidentally transpired that the entire drainage of the cemetery is conducted into a neighboring ditch, which discharged itself into the river Wandel, from which many of the inhabitants are accustomed to draw their supplies of water.

Not so Bad.—The *Phila. Medical Times* gives a report of a student undergoing his examination, who, when requested to describe the *modus operandi* of disinfectants, replied: "They smell so badly that the people open the windows, and the fresh air gets in."

A recent test of the relative strength of oak and Oregon pine, made at San Francisco, with bars each one inch square and three feet long, showed that the pine was equal to the oak. Both broke under the same weight placed in the middle of each bar—200 pounds.

Too Bad.—A new town in the California quicksilver region is named Mercury. What class of operators that heathen deity presided over every schoolboy knows.

From Englewood, N. J., we learn that the Hackensack Water Company has offered to supply them with water if they will assume $30,000 of the company's bonds at par.

In this community it is also stated that "the town authorities having refused to provide street lamps, a number of citizens, at the instigation of Mr. R. J. Hunter, have placed lamps in front of their own premises, and have them lighted and cared for by their own domestics. The plan works well and is infinitely cheaper than gas."

"Infinitely" is a big word.

The *Ironmonger* says that the average cost of a ton of coal, as purchased by the London gas companies in 1873 was £1 4s. 6·14d., the total outlay being £1,753,715. In 1872 the average was 17s. 6·51d. per ton; in 1871, 15s. 9·72d.; in 1870, 16s. 3·54d.; and in 1869, 16s. 3·75d. Accordingly, these figures show between 1879 and 1873 a rise of 50 per cent. in the price of coal as purchased by the London gas companies.

The *Iron Age* improves the occasion of a boy in Detroit getting a brass kettle fixed immovably on his head; he comments: It is strange they didn't think to carry him to a brass foundry and have it melted off. Or they might have dissolved it off by laying the boy to soak in a tank of dilute sulphuric acid. It is curious how thoughtless some people are in moments of emergency.

[Our *confrere* meant *nitric* instead of sulphuric acid. He deserves encouragement, however.)

IMPORTANT

To Gas Manufacturers.

It has recently been discovered by actual tests, under various circumstances, that the

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as manufactured by the

Huntoon Governor Co.,

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Cast Iron Gas and Water Pipe—Jno. McNeal & Sons, Burlington, N. J.....8
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Gas Purification—St. John and Cartwright.....5
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West End Supply Company—Chas. H. Brown, 25, 27 and 29 North 20th street, Phila, Pa.....4
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Gas Meter Manufacturers—Harris & Bro., 1117 Cherry st., Philadelphia, Pa.....11
Gasometers, Etc.—Geo. Stacey & Co., Cincinnati, O.....
Gas Fixtures, Etc.—Archer & Paccoast Manufacturing Co. 67 Greene Street, above Broome, N. Y.....2
Gas Fixtures, Etc.—Mitchell, Vance & Co., 597 Broadway..7
Gasholders, Etc.—Deily & Fowler, 39 Laurel st., Phila., Pa..4
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Gasometers, &c.—Keystone Iron Works—2132 Filbert st., Philadelphia.....2
Gas Screens—American Gas Screen Manufacturing Co., Haverhill, Mass.....4
Jersey City Gas Meter Works, 14 Morris st., Jersey, N. J....8
Lime Hurdles.—Manhattan Lime Hurdle Co., Geo. W. Day, Treas., No. 3 Railroad Square, Haverhill, Mass.....2
Lava Tips and Scotch Tips—Charles H. Meyer & Co., 227 Chestnut street, Phil. Pa.....8
National Tube Works Co., 18 William St., N. Y.....7
Patent Conically Slotted Wood Trays—John L. Cheesman, 147 and 149 Avenue C., N. Y.....4
Patent Gas Exhauster—Smith & Sayre, 95 Liberty street..4

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Cannelton Coal Co. of West Virginia—J. Tatnall Lea, 325 Chestnut street, Phila, Pa.....3
Despard Coal Co.—Parmelee & Bros., Agents, 32 Pine st., New York.....7
Gas Coals—Bird, Perkins & Job, 27 South st., N. Y.....7
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New York and Cleveland Gas Coal Company—384 Fifth Avenue, Pittsburgh, Pa.....9
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Peytona Cannel Coal—S. E. Low, 58 Broadway, N. Y.....5
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Sterling Coal—Freeman Butts, Cleveland, Ohio.....6
The Newburg Orrel Coal Co.—Chas. W. Hays, Agent in New York, Trinity Building, 111 B'way, Room 7.....6
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Continental Works—T. F. Rowland, Greenpoint.....6
Camden Iron Works, Camden, N. J.—Jesse W. Starr & Sons 5
Gloucester Iron Works—J. P. Michelton, Sec., 6 North 7th street, Phila., Pa.....4
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Pascal Iron Works—Morris, Taskar & Co., Philadelphia....12
Providence Steam and Gas Pipe Co., Providence, R. I.—H. A. Branch, Agent.....3

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Cheltenham Fire Brick and Clay Retort Works—Evens & Howard, 916 Market street, St. Louis, Mo.....
Jersey City Fire Brick Works—J. H. Gautier & Co., Greene, Essex and Bergen sts., Morris Canal Basin, N. J.....8
Manhattan Clay Retort Works, 15th st., near Av. C, N. Y.. 8
Philadelphia Fire Brick Works, Vine and 23d sts., Phila.... 8
Retorts, Etc.—Geo. C. Hicks & Co., Baltimore Md.....1

LAMPS, STOVES, PETROLEUM, ETC.

Patent Lamp Post—J. W. Graham, Chillicothe, Ohio, or A. M. Callender, office of this Journal.....9

MISCELLANEOUS.

Analysis and Testing of Gas Coals—Prof. Henry Wurtz, 12 Hudson Torrace, Hoboken, N. J.....10
Architect and General Gas Engineer—William Farmer, 111 Broadway Room 95.....5
American Gas Works Construction and Supply Company—61 Broadway, N. Y.....3
Cements—S. L. Merchant & Company, 76 South st., N. Y....
Contractors for Gas Works, Etc.—Murray & Baker, Fort Wayne, Ind.....2
Fodell's System of Bookeeping—A. M. Callender & Co., 42 Pine st., New York.....10
Gas Engineer—B. E. Cholar, 914 Olive St., St. Louis, Mo... 6
Gear Wheels—Scott, 98 Chambers St., N. Y.....5
Gas-Light Company of America, 63 and 64 Drexel Building, New York.....2
Kidd's Gas Consumers Guide—A. M. Callender & Co., 42 Pine Street, N. Y.....
Massachusetts Institute of Technology—Samuel Kneeland Boston, Mass.....
National Coal Gas Company—H. P. Allen, 4 Warren street New York.....6
Retort Setting and Working—E. S. Cathels, Montreal, Can. 8
School of Mines, Columbia College, East 49th st.....9
Screening Shovels—O. R. Butler, 126 Maiden Lane, N. J.... 7
Scientific and Practical Chemist and Geologist—Profetsor Henry Wurtz, 12 Hudson Terrace, N. J.....
Screening Shovels—G. W. Dean, 1358 Broadway, N. Y.....
Springfield Gas Machine—Corner Canal and Centre St.....
Slade's Automatic Fire Governor—Jas. Slade, Gas Works, Yonkers, N. Y.....4
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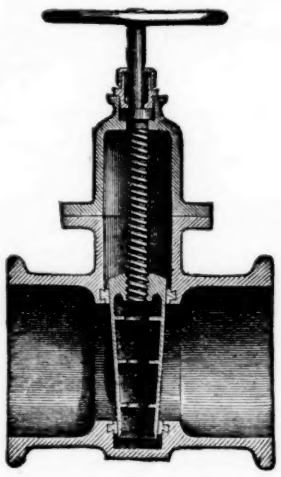

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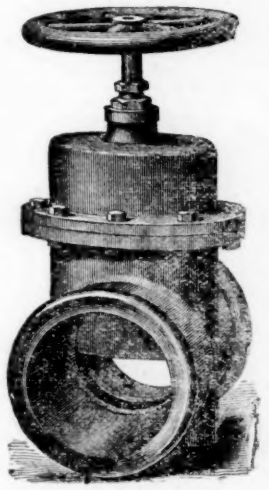

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CITIZENS GAS-LIGHT COMPANY, BROOKLYN, N. Y.
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CHARLESTOWN GAS-LIGHT CO., CHARLESTOWN, MASS.
LYNN GAS-LIGHT COMPANY, LYNN, MASS.
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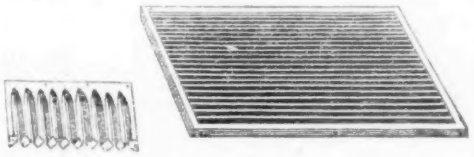
PATENTED OCTOBER 21, 1862 AND JUNE 10, 1873.



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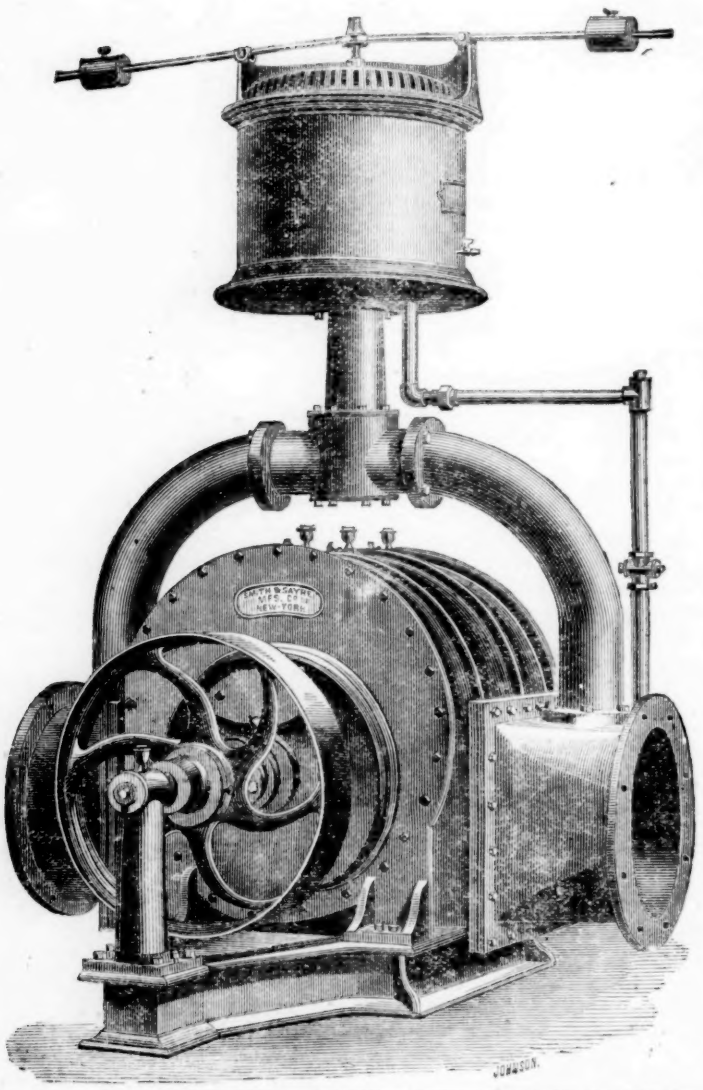

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The Blower is a Force Blast machine, durably built, and can be driven with one-third the power required to drive the ordinary Fan. The Cupolas are manufactured in sizes to melt from 1 to 20 tons per hour, will save one quarter of the time required by the old style Cupola, and 33 per cent fuel. Address

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Ince Hall	$17 00	@	18 00
Kirkless Hall	16 50	@	17 00
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Newcastle Gas	$12 00	@	00 00
Liverpool caking	11 50	@	12 00
British Province Coals.			
Pictou	2 50		
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Caledonia—At Mines, $2 00, Gold	0 00		
Little Glace Bay—At Mines, 1 87½, Gold	2 00		
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" Reserve Mine	2 25		
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MurphyRun	$7 40	@	0 00
Despard	7 40	@	0 00
West Fairmont	7 40	@	0 00
American Gas Coal	7 40	@	0 00
Fairmont	7 40	@	0 00
Newburgh Orrel	7 40	@	0 00
Pinnickinick	7 40	@	0 00
Cloverhill of Virginia	6 00	@	6 50
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Peytona of West Virginia	$12 50	@	00 00
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Cannelton Cannel			12 50
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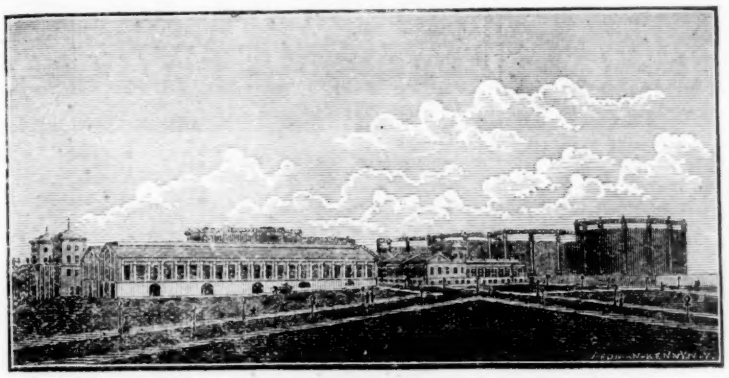

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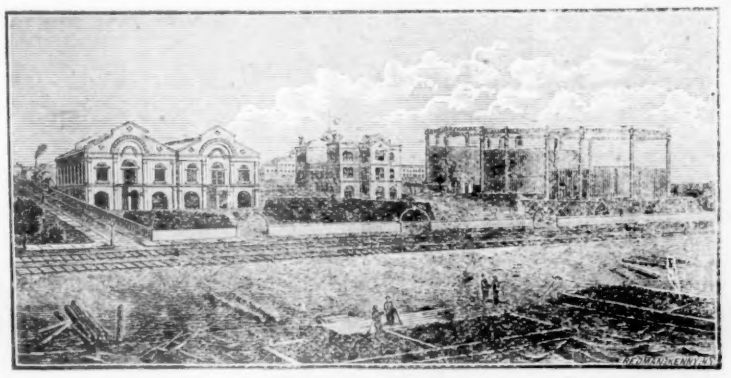

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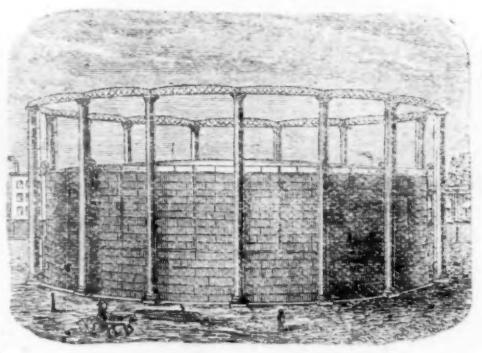

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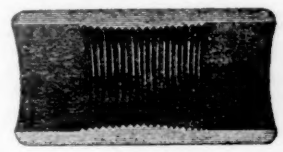

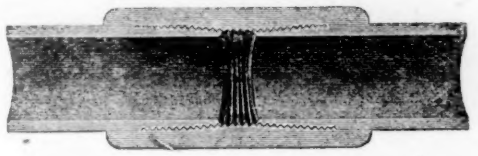

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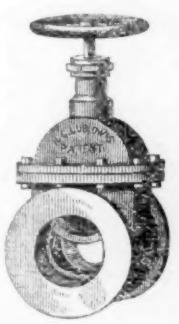

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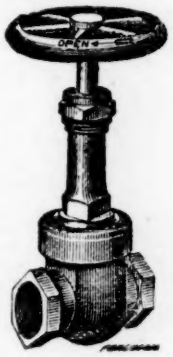

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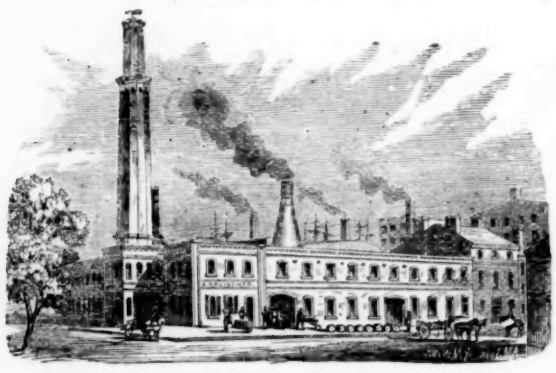

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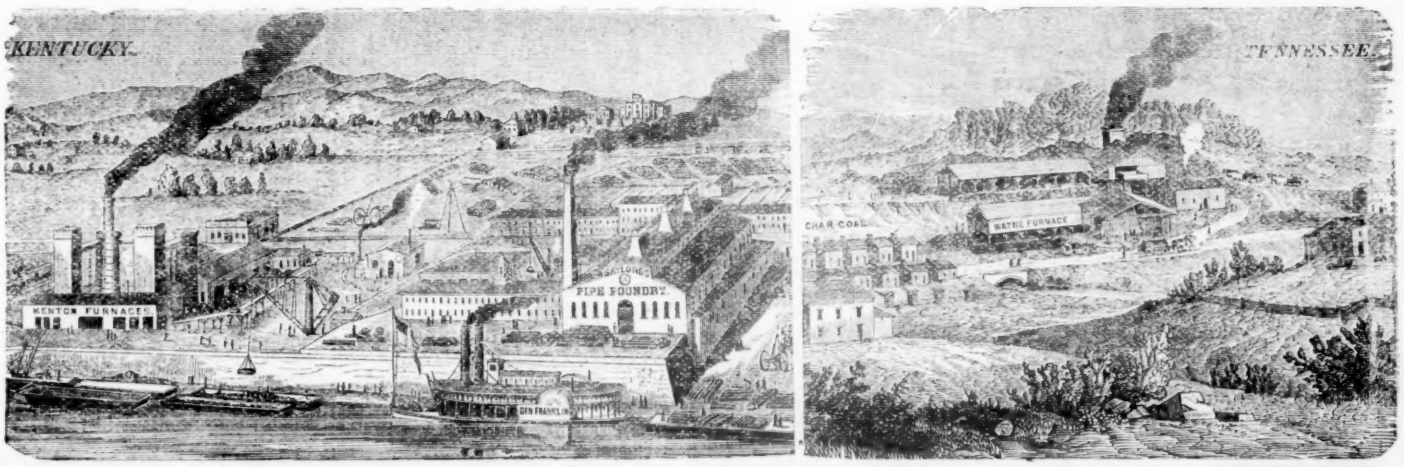

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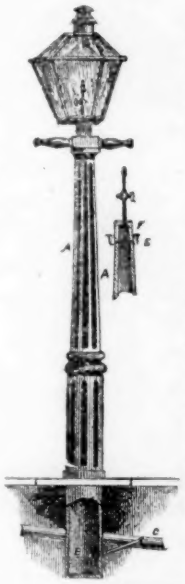

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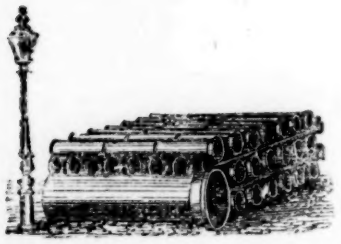

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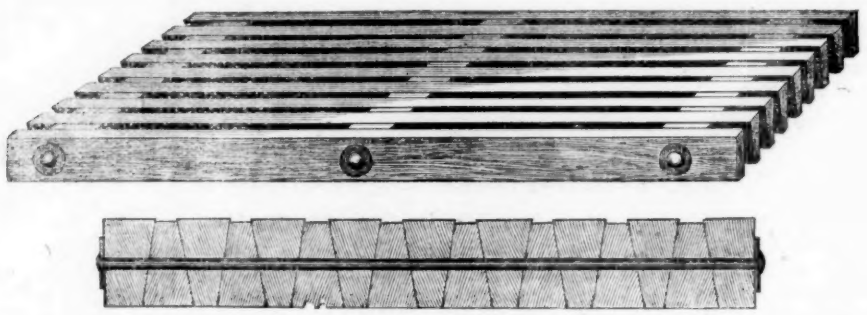

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